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EFFECT OF ARTIFICIAL MANURE ON NITRIFICATION IN CARRINGTON LOAM

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The value of farmyard manure in maintaining soil fertility is well known. Recently, considerable interest has been manifested in a process of making artificial farmyard manure from straw and corn stalks. The process is still in the experimental stage and only a small amount of artificial manure is being produced. However, it seems desirable to study the effect of artificial manure compared with farmyard manure on soil conditions and crop yields. The purpose of this paper is to present some results secured on the effects of artificial manures, farm manure, green manures and crop residues on nitrification in Carrington loam.

As an index of soil fertility and certain bio-chemical conditions in the soil, nitrification is very useful. The modifications of the original method of determining the nitrifying power of the soil which have been suggested from time to time no doubt contribute toward completing the picture of the conditions. However, an explanation of the results secured cannot be given without information regarding the nitrate assimilating power of the soil also, since the nitrate content of the soil at any given time is the resultant of nitrate production on the one hand and nitrate utilization on the other. In this study, the nitrate assimilating power of the soil was determined as well as nitrate accumulation and the nitrifying power.

Virgin Carrington loam was treated in 4 gallon pots with one percent of the finely ground materials. The moisture content of the soils was adjusted to 50 percent of the saturation capacity and maintained by frequent additions of water. One week after the soils were treated, samples were drawn for analysis. The nitrate content was determined on duplicate 100 gram portions by the colorimetric method. Six 100 gram equivalents of dry soil were weighed into tumblers from each soil treatment. To one set of tumblers in duplicate was added 210 milligrams of $CaCO_3$ and 30 mgm. of nitrogen as ammonium sulfate, to another set was

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added 2 grams of dextrose and 30 mgm. of nitrogen as KNO_3 and a third set was left untreated as a check. The moisture content of all soils was adjusted to 30 percent and the tumblers placed in the incubator at room temperature for 4 weeks. After incubation the nitrate content was determined. The nitrate assimilating power of the soil was determined by measuring the amount of nitrates the soil was able to utilize in the presence of an excess of nitrates and with 2 percent of dextrose as energy material. These figures then were obtained by subtracting the amount present after incubation from the amount present in the untreated soil after incubation plus the amount in the addition. While this method of determining the nitrate assimilating power of the soil is not perfect, it is the most satisfactory method available at present.

The first column of figures in the table shows the amount of nitrate nitrogen which had accumulated in the soils variously treated after 1 week in the greenhouse. No nitrate nitrogen had accumulated in the soil treated with oats straw and the nitrates present had disappeared. Similar effects were brought about by the corn stalks, a trace of nitrate nitrogen remaining in this soil at the end of one week. The nitrate content of the soil treated with farm manure was about the same as that of the untreated soil. The Adco manures increased the nitrate content of the soil considerably while only a slight increase was observed in the soil treated with the ammonium sulfate manure. Both the sweet clover tops and roots brought about a large increase in nitrate content of the soil.

The nitrate assimilating power of the soils treated with oats straw and corn stalks were very little affected, the one being slightly higher than the untreated check and the other slightly lower. The nitrate assimilating power of the soils treated with the artificial manures were reduced, particularly in the soil treated with Adco-stalk manure. With a given nitrifying power, these soils should result in a higher accumulation and to an extent this was obtained. The sweet clover tops and roots both increased the nitrate assimilating power of the soil. A high nitrate accumulation and a high nitrate assimilation indicate a very marked stimulation of nitrification.

The farmyard manure and the artificial manures were well decomposed and contained easily nitrifiable nitrogen, particularly the Adco manures, which stimulated nitrification as shown by the figures in the last two columns. The straw and corn stalks de-

pressed nitrification. This is shown by the fact that nitrates did not accumulate in soils treated with these materials, the nitrate assimilating power was not increased at all or only slightly and that nitrates were not produced in sufficient amounts to accumulate in the soils treated with these materials and incubated. Sweet clover tops contained a large amount of nitrifiable nitrogen but the nitrifying power was stimulated less by the tops than by the roots of sweet clover. Probably this was due to the production of large amounts of ammonia which tended to depress nitrification.

In general the results show that well decomposed farm manure and artificial manures contain easily nitrifiable nitrogen, the nitrate assimilating power of the soil is increased only slightly or not at all and nitrification is stimulated when these materials are incorporated with the soil. On the other hand straw and corn stalk residues added to the soil increase nitrate assimilation, depress nitrification and as a result nitrates do not accumulate in the soil. The sweet clover tops and roots used as green manures stimulate nitrification to such an extent that even with an increased nitrate assimilation nitrates accumulate rapidly.

In conclusion it is emphasized that the nitrate assimilating power of the soil should be determined along with nitrate accumulation and the nitrifying power of the soil in nitrification studies when it is desirable to secure complete information regarding the process.

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Mgm. NO_3-N. per 100 grams of dry soil

Treatment	NO_3 Accumulation	Nitrate Assimilating Power	Nitrifying Power	
			Soil, Alone	Soil + 30 Mgm. N. as (NH_4SO_4) + 210 Mgm. $CaCO_3$
Check	0.78	19.38	1.89	9.07
Farmyard manure	0.80	19.46	1.93	11.15
Adco manure — straw	1.02	18.24	2.56	11.15
Adco manure — stalk	1.02	17.70	2.11	14.92
Am. Sul. manure	0.94	18.53	1.87	11.20
Oats straw	0	19.60	0	10.17
Corn stalks	trace	18.59	trace	10.85
Sweet clover tops	1.67	24.02	8.80	13.40
Sweet clover roots	1.51	20.40	3.59	16.00

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